35 97/14716

PCT

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H04B 1/38, H04Q 7/32, H04M 1/72

A1

(11) International Publication Number: WO 95/02927

(43) International Publication Date: 26 January 1995 (26.01.95)

(21) International Application Number: PCT/US94/07617

(22) International Filing Date: 8 July 1994 (08.07.94)

(30) Priority Data:
093,076 16 July 1993 (16.07.93) US

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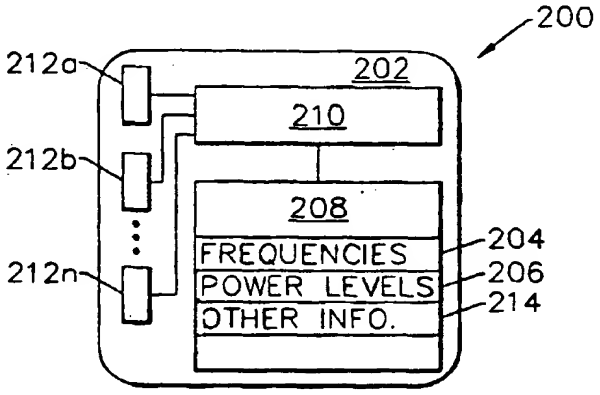
(81) Designated States: FI, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND APPARATUS FOR CONTROLLING TRANSCEIVER OPERATIONS IN A RADIO COMMUNICATIONS SYSTEM



(57) Abstract

Transceiver frequency and power level are allocated in a radio communications system which includes a base station, a radio personal communications terminal, and a radio personal communications network, by using a smart card to store frequency and power level indicators. The stored indicators are used to set personal communications terminal-to-base station communications. The smart card may be removably coupled to the base station or the personal communications terminal. Since the smart cards are issued by the radio personal communications system carrier, appropriate frequencies and power levels can be assigned for base stations, to minimize same channel interference with the radio personal communications network.

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METHOD AND APPARATUS FOR CONTROLLING TRANSCEIVER OPERATIONS IN A RADIO COMMUNICATIONS SYSTEM

Field of the Invention

This invention relates to communications systems and more particularly to radio communications systems.

Background of the Invention

Radio communication systems are increasingly being used for wireless mobile communications. An example of a radio communication system is a cellular phone system. The design and operation of an analog cellular phone system is described in an article entitled *Advanced Mobile Phone Service* by Blecher, IEEE Transactions on Vehicular Technology, Vol. VT29, No. 2, May, 1980, pp. 238-244. The analog mobile cellular system is also referred to as the "AMPS" system.

Recently, digital cellular phone systems have also been proposed and implemented using a Time-Division Multiple Access (TDMA) architecture. Standards have also been set by the Electronics Industries Association (EIA) and the Telecommunications Industries Association (TIA) for an American Digital Cellular (ADC) architecture which is a dual mode analog and digital system following EIA/TIA document IS-54B. Telephones which implement the IS-54B dual mode

architecture are presently being marketed by the assignee of the present invention.

Different standards have been promulgated for digital cellular phone systems in Europe. The European digital cellular system, also referred to as GSM, also uses a TDMA architecture. The GSM also uses a Subscriber Identification Module (SIM) which is removably coupled to a cellular phone in order to provide subscriber identification. The SIM is implemented using a "smart card", also referred to as a "chip card", which contains information such as a subscription number, telephone number and authentication codes in an embedded chip. The SIM can be exchanged between telephone units so that the user can insert the SIM into any compatible telephone. Cellular telephones using smart cards are also described in U.S. Patents 5,091,942 to Dent; 5,134,717 to Soggard Rasumussen; and 5,153,919 to Reeds, III et al. Citizens band (CB) radios are also known, which use removable crystals to set oscillator frequency.

Proposals have recently been made to expand the cellular phone system into a radio personal communications system. The radio personal communications system provides mobile radio voice, digital, video and/or multimedia communications using radio personal communications terminals. Thus, any form of information may be sent and received. Radio personal communications terminals include a radio telephone, such as a cellular telephone, and may include other components for voice, digital, video and/or multimedia communications.

A radio personal communication system includes at least one base station. A base station is a low power transceiver which communicates with a radio personal communications terminal such as a cellular telephone over a limited distance, such as tens of meters, and is also electrically connected to the

conventional wire network. The base station allows the owner of a radio personal communications terminal to directly access the wire network without passing through the radio personal communications network, such as the cellular phone network, whose access rates are typically more costly. When located outside the range of the base station, the personal communications terminal automatically communicates with the radio personal communications network at the prevailing access rates.

A major problem in implementing a radio personal communication system is the frequency overlap between the radio personal communications network (e.g., cellular phone network) and the base station. As understood by those having skill in the art, only a limited number of frequencies are available for radio communications. In the United States, cellular telephones have been allocated 832 30kHz wide channels. Within this spectrum, each regional provider can substantially allocate and use these frequencies as it sees fit.

In a radio personal communications system, it is assumed that base station transmission will be in the same frequency spectrum as the radio personal communications network. Accordingly, the possibility of same channel interference arises when a base station is operating at the same channel as the network covering the same area.

Frequency overlap between the network and the base stations can be prevented if the network and base stations are allocated different bands of frequencies. However, such a hybrid system is not an efficient allocation of the frequency spectrum. Moreover, a hybrid personal communications terminal may be more expensive and complicated because additional circuitry may be required. Accordingly, in order to efficiently provide a radio personal communications system, it is

desirable to provide base stations which operate in the same frequency bands as the radio personal communications networks, while avoiding same channel interference.

Summary of the Invention

It is therefore an object of the present invention to provide an improved radio personal communications system and method.

It is another object of the present invention to provide a radio personal communications system and method wherein same channel interference between the radio personal communications network, such as the cellular telephone network, and the base stations, are reduced.

These and other objects are obtained, according to the present invention, by providing frequency indicating means, preferably a smart card, for storing therein an indicator of at least one radio transmission frequency. The radio personal communications terminal and/or base station is adapted for removably coupling the frequency indicating means thereto and for controlling the radio personal communications terminal and/or base station to operate at a frequency corresponding to a frequency which is stored in the smart card. Since the smart cards are issued by the radio personal communications system carriers, appropriate frequencies can be assigned for the base stations, to minimize same channel interference with the radio personal communications network. Moreover, by allowing radio personal communications system carriers to lease unused frequencies via smart cards, additional revenue may be generated from these frequencies.

Preferably, according to the invention, the frequency indicating means (smart card) also stores therein a second indicator of at least one power level,

and the radio personal communications terminal and/or base station operates at a frequency and power level corresponding to that which is stored in the smart card. The base station is preferably adapted for removably receiving the frequency and power level indicating means (smart card) and for controlling the transmission frequency and power of the base station to correspond to the stored frequency and power level. A stored frequency and power level are also preferably provided to the personal communications terminal which communicates with the base station, so that the terminal also transmits at a frequency and power level which is compatible with that of the base station.

Alternatively, the frequency and power level indicating means (smart card) may be contained within the radio personal communications terminal. Then, when establishing contact with the base station, the terminal can set the frequency and power level of the base station and of the terminal based on a power level and frequency stored in the smart card.

In a method according to the present invention, a base station for a radio telephone network is operated to reduce same channel interference with the radio telephone network by electrically connecting the base station to a wire telephone network and by receiving a frequency indicating signal, and also preferably a power level indicating signal, from a source external to the base station. The base station transceiver is then operated at a frequency, and preferably at a power level, corresponding to the received frequency and power level indicating signals. Preferably, the frequency and power level indicating signals are received by removably coupling a smart card, including a stored indication of at least one radio transmission frequency and power level, to the base station, and obtaining from the coupled smart card, signals representing the at least one radio

transmission frequency and power level. The base station also preferably transmits a frequency and power level signal, based upon the stored indicators to a radio telephone with which it communicates, so that the radio telephone also can operate at a frequency and power level which is compatible with the base station.

In an alternate method, the radio telephone is adapted for removably coupling a smart card thereto, where the smart card includes at least one stored indication of the radio transmission frequency and preferably a power level. The radio telephone transceiver is controlled to operate at a frequency and power level corresponding to the stored frequency and power level in the smart card. The radio telephone also transmits signals representing a radio transmission frequency and preferably a power level, to the base station, so that the base station can operate at this power level.

The use of smart cards for storing frequency and power level indications allows the network operator to assign frequencies for base stations which minimize same channel interference with the radio network. The system carrier also can obtain additional revenue from unused frequencies within a network cell by leasing these frequencies for base station operation within the cell. An improved radio personal communications system and method is thereby provided.

Brief Description of the Drawings

Figures 1A and 1B schematically illustrate a radio personal communication system including a base station and a radio personal communications terminal, with radio communications between the terminal and the base station, and radio communications between the terminal and a radio personal communications network, respectively.

Figure 2 is a schematic block diagram of frequency and power level indicating means according to the present invention.

Figure 3 is a schematic block diagram of a base station according to the present invention.

Figure 4 is a schematic block diagram of a base station radio frequency transceiver according to the present invention.

Figure 5 is a schematic block diagram of a radio personal communications terminal according to the present invention.

Figure 6 is a flowchart illustrating operations of a radio personal communication system according to the present invention.

Description of Preferred Embodiments

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

Referring now to Figures 1A and 1B, conceptual diagrams of a radio personal communications system are shown. As shown in Figure 1A, radio personal communications system **100** includes at least one radio personal communications network **102**, such as a cellular telephone cell, for transmitting and receiving messages in a network range indicated by **104**, via cell antenna **106**. Network **102** also interfaces with the wired network **108**. It will be understood by those having skill in the art that a radio personal communication system **100** typically includes many radio

personal communication networks, or cells, **102** to cover a large area.

Still referring to Figure 1A, system **100** also includes a base station **110**. Base station **110** includes a low power transceiver for transmitting and receiving via base station antenna **112**, over a limited base station range **114**, typically on the order of tens of meters. Thus, a base station may be used for transmission and receipt of radio personal communications in a home or office. Base station **110** also is electrically connected to the wire network **108**.

Still referring to Figure 1A, a radio personal communications terminal **120** is shown for radio communications with both base station **110** and network **102** via antenna **122**. Radio personal communications terminal includes a radio telephone such as a cellular phone. Radio personal communications terminal **120** may also include, for example, a full computer keyboard and display, a scanner, and full graphics and multimedia capabilities.

As illustrated in Figure 1A, when terminal **120** is in the range **114** of the base station **110**, a radio link **124** therebetween is automatically established. As shown in Figure 1B, when the terminal **120** is outside the range **114** of the base station **110**, but within the range **104** of the network **102**, a new radio link **126** is automatically established with the network **102**. Thus, when the user is relatively close to the base station **110** (i.e. within the home or office), wireless communications take place with the base station so that the radio personal communications network **102**, with its higher rate structure, is bypassed. When the user is relatively far from the base station **110**, communications take place with the network **102**.

It will be understood by those having skill in the art that a complete radio personal

communications system 100 will typically include many base stations 110, terminals 120 and radio networks (cells) 102. It will also be understood by those having skill in the art that conventional communications and handoff protocols may be used with the present invention, and need not be described further herein. For purposes of this description, it will be assumed that the spectrum allocation is the IS-54B cellular phone spectrum allocation which is illustrated in Table 1 below.

TABLE 1

System	Bandwidth (MHz)	Number of Channels	Boundary Channel Number	Transmitter Center Frequency (MHz)	
				MOBILE	BASE
Not Used		1		(824.010)	(869.010)
A"	1	33	991 1023	824.040 825.000	869.040 870.000
A	10	333	1 333	825.030 834.990	870.030 879.990
B	10	333	334 666	835.020 844.980	880.020 889.980
A'	1.5	50	667 716	845.010 846.480	890.010 891.480
B'	1.5	83	717 799	846.510 848.970	891.510 893.970

Transmitter	Channel Number	Center Frequency (MHz)
MOBILE	1 ≤N≤ 799 990 ≤N≤ 1023	0.030 N + 825.000 0.030 (N-1023) + 825.000
BASE	1 ≤N≤ 799 990 ≤N≤ 1023	0.030 N + 870.000 0.030 (N-1023) + 870.000

In the radio personal communication system 100 described in Figures 1A and 1B, it is important to avoid same channel interference between base station 110 and network 102. According to the invention, the operator of network 102, which has been assigned the

use of the frequency spectrum in the region by a regulatory authority, is allowed to assign frequencies and preferably power levels, of base station **110**. The network operator can assign frequencies and preferably power levels to base station **110** to minimize same channel interference and to maximize revenue from the assigned frequency spectrum. Frequency indicating means, in the form of a smart card, removable memory module or other token, is removably coupled to the base station **110** or personal communications terminal **120** to provide frequency information, and also preferably power level information, which governs terminal-to-base station communications.

Figure 2 illustrates a frequency and power level indicating means according to the invention. As shown, frequency and power level indicating means **200** is preferably a smart card **202**, also referred to as a "chip card", or other token, which includes memory means **208** for storing therein indications of at least one radio transmission frequency **204** and at least one power level **206**. Memory **208** is preferably an electrically erasable programmable read only memory (EEPROM), which operates under control of a controller **210**. A plurality of smart card electrical contacts **212a-212n**, only three of which are illustrated in Figure 2, allow communication of the frequency and power level indicators **204**, **206** external to the smart card **202**. It will be understood by those having skill in the art that memory **208** may also contain other information **214**, for example identification information such as subscription number, telephone number and authentication codes, and/or other preprogrammed telephone numbers. A smart card is currently used in the European digital cellular system (GSM) for purposes of subscriber identification. The GSM smart card is referred to as a Subscriber Identification Module (SIM)

and is described in International Standards ISO 7816-1, -2, and -3.

Figure 3 illustrates a block diagram of a preferred embodiment of the present invention, in which a base station **110** includes means for removably coupling the frequency and power level indicating means **200** thereto. Figure 3 illustrates a recess **302** for removably coupling the frequency and power level indicating means **200** to base station **110**. However, other removable coupling arrangements may be provided. Contacts **212a-212n** electrically contact corresponding base station contacts **304a-304n** for obtaining signals representing the frequency and power level indications **204, 206** from smart card **202**. It will be understood that electromagnetic, optical or other means may also be used to obtain the signals from the removably coupled smart card **202**.

According to the invention, base station **110** uses the obtained frequency and power level **204, 206**, respectively, to govern operation of base station **110**. Frequency and power level signals are also preferably used to control operation of the radio personal communications terminal **120** as will be described below. As will also be described below the terminal **120** may be controlled to operate at the same frequency and power level as base station **110**. Alternatively, a different frequency and power level may be provided. If a different frequency or power level is used, smart card **202** may store multiple frequencies **204** and power levels **206**. Alternatively, the base station **110** or terminal **120** may determine the second frequency and power level from a single stored indication in smart card **202**. The base station **110** is preferably configured so that it will not operate without a frequency and power level indicating means **200** coupled thereto. Thus, the network operator can receive revenue from the use of the frequency, and simultaneously prevent radio

communications between base station 110 and terminal 120 from interfering with the cellular network.

Referring again to Figure 3, the remaining circuitry of base station 110 will now be described. The design of the remaining circuitry of base station 110 is well known to those having skill in the art, and need not be described in detail. Microprocessor 360, for example a Zilog Z80 microcontroller, controls the base station 110. Radio transceiver 310 provides two-way communications with the terminal 120 and network 102 via antenna 112. Signals received by antenna 112 are down converted by the radio transceiver 310, and provided to a demodulator 315. The demodulator produces a bit stream, i.e. a sequence of binary data representing the received data. The bit stream is then provided to the receive digital signal processor (DSP) 355, where it is converted to an analog audio signal according to methods well known to those having skill in the art. The resultant analog signal is transferred to the subscriber loop interface circuit 345. Loop interface circuit 345 is a commonly used circuit which provides the interface to the wired network 108, also referred to as the Public Switched Telephone Network (PSTN). PSTN 108 is the regular "wire line" telephone system supplied by, for example, the regional Bell Operating Companies, and may use copper wire, optical fiber or other stationary transmission channels.

Still referring to Figure 3, receive DSP 355 is controlled by microprocessor 360. Microprocessor 360 provides timing signals and instructions. Operating instructions for the receive DSP 355 are typically contained in electrically erasable programmable read-only memory (EEPROM) 330. Flash ROM 335 typically contains instructions for the microprocessor 360 itself. These instructions are uploaded into the microprocessor 360 during initialization. SRAM 325 is a static random access

memory which is typically used by the DSP **355** and the microprocessor **360** as a scratch pad memory for temporary storage of information. Power management and distribution circuits **340** are also connected to microprocessor **360**.

To transmit, signals received from wire network **108** are coupled to the transmit DSP **320** by a loop interface circuit **345**. The transmit DSP **320** digitizes the analog signal and converts it into a bit stream which is then passed onto the modulator **305**. The transmit circuits basically perform complementary functions to those already described for the receive circuits.

Figure 4 illustrates a schematic block diagram of a radio transceiver **310** of Figure 3. As shown, transceiver **310** includes circuitry for both the reception and transmission of the radio frequency signals. Signals received by the antenna **112** are directed to the receive circuits by the duplexer **401**. The duplexer is a filter with two separate bandpass responses: one for passing signals in the receive band and another for passing signals in the transmit band. In the ADC architecture, described above, the receive and transmit frequencies are separated by 45 mHz. The duplexer **401** allows simultaneous transmission and reception of signals.

After passing through the duplexer **401**, received signals are amplified by a low noise radio frequency (RF) amplifier **402**. This amplifier provides just enough gain to overcome the expected losses in the front end circuitry. After amplification, unwanted components of the signal are filtered out by the receive filter **403**. After filtering, the signal is mixed down to a first intermediate frequency (IF) by mixing it in mixer **404** with a second signal generated by the channel synthesizer **415** and filtered by Local Oscillator (LO) filter **414**. The first IF signal is

then amplified by amplifier **405** and unwanted mixing products are removed by IF filter **406**. After filtering, the first IF is mixed in mixer **407** to yet another lower frequency or second IF signal, using a signal provided by local oscillator synthesizer **416**. The second IF signal is then filtered by two filters **408** and **410**, and amplified by multistage amplifiers **409** and **411** to obtain an IF signal **412** and a radio signal strength indication (RSSI) signal **413**. Thereafter, it undergoes a process of detection, for example, as described in U.S. Patent 5,048,059 to Dent, the disclosure of which is incorporated herein by reference.

In order to transmit, a datastream **419** is generated by the transmit DSP **320** (Figure 3). In ADC architecture, the datastream is organized as bursts for time division multiplexing with other users. Reference oscillator **418** generates a precise frequency which is used as a stable reference for the RF circuits. The output of oscillator **418** is passed through a multiplier **421** where it experiences a sixfold increase in frequency. This frequency is then passed into a quadrature network **422** which produces two signals of equal amplitude which have a quadrature phase relationship, i.e. they are offset by 90°. These quadrature signals, along with the datastream **419**, are combined in the modulator **423** to create a modulated signal, as described in an article entitled *I and Q Modulators for Cellular Communications Systems*, D. E. Norton et al., Microwave Journal, Vol. 34, No. 10, October 1991, pp. 63-79. The modulated signal is passed to a mixer **424** which translates the signal to radio frequency. The exact radio frequency is determined by the local oscillator signal provided by the channel synthesizer **415**. The radio frequency signal is passed through a variable gain controlled amplifier **425**. The gain of this amplifier, which is

controlled by means of a voltage on transmit power control line **420**, determines the eventual output power, since the linear power amplifier **427** has fixed gain. Filtering is performed by transmit filter **426**.

According to the invention, a frequency indicator **204** stored in smart card **202** is converted to a synthesizer command and applied to line **417** to produce the requisite transmit and receive frequency. A power level indicator **206** stored in smart card **202** is converted to a transmit power control signal and applied to line **420** to control the transmit power. The conversions are preferably performed by microprocessor **360** using conventional techniques. Operations performed to set the frequency and power level will be described below in connection with Figure 6.

Referring now to Figure 5, according to another embodiment of the invention, frequency and power level indicating means **200** can also be used in radio personal communications terminal **120** to control the frequency and power level thereof and/or to control the frequency and power level of base station **110** by radio transmission. The design of terminal **120** is similar to that of base station **110** (Figure 3) except that a loop interface circuit **345** is not present. When terminal **120** is a cellular phone, it includes a keypad **502**, a display **504**, a speaker **506**, and a microphone **508**. In order to provide a radio personal communications terminal for receipt and transmission of audio, video and data and/or multimedia signals, keypad **502** may be a full scale personal computer keyboard and display **504** may be a large graphics display. A scanner **510** may also be provided as may other devices **512** such as disk drives and modems. Apart from the use of smart card **200** for setting power levels and frequencies, the design of terminal **120** is well known to those having skill in the art and need not be described herein.

Referring now to Figure 6, operations for controlling frequency and power level of a personal communications terminal and/or a base station, based upon stored frequency and power level information from a smart card, according to the invention, will now be displayed. It will be understood that other operations may be used.

Operations begin when power is applied to terminal **120** at Block **602**. Upon application of power, the terminal **120** scans a set of control channels which are allocated to base stations **110**, and determines if a signal level above threshold has been detected, at Block **606**. It will be understood that each base station **110** is typically allocated only one of the set of control channels. If a signal level above threshold has been detected, then terminal **120** is within the range **114** of base station **110**. If a signal level above threshold was not detected, then the terminal **120** is not within the range of base station **110** and communications are initiated with network **102** at Block **608**, using conventional techniques.

Referring again to Block **606**, if a base station control channel signal above threshold is detected, the terminal **120** locks onto the strongest signal at Block **610**. Once locked on, terminal **120** performs a registration at Block **612**. Similar to cellular phone systems, this registration information occurs at a predetermined power level and a predetermined frequency which depends upon the control channel which has been locked.

During the registration process, the base station **110** instructs the terminal **120** to tune to another frequency, to which the base station opens a channel and transmits at a defined power level. This can be the same frequency and power level which is determined by the frequency and power level indicators, or can be a different frequency and power level. Once

the transfer has been completed, the base station drops the control channel frequency to prevent another user from attempting to use the same base station.

According to the invention, the stored frequency and power level indicators are obtained from the smart card **202** which is preferably removably coupled to the base station **110**, but which may also be removably coupled to the terminal **120**. At Block **616**, the obtained frequency and power levels are converted to signals which are used to set the synthesizer **415** and amplifier **425** for the unit which is removably coupled to the smart card. Signals representing a frequency and power level (the same frequency/power level or different frequency/power level) are then transmitted to the other unit, which does not contain the smart card, at Block **618**. That unit uses the received frequency and power level signals to set its synthesizer and amplifier at Block **620**. Communications then take place between the base station **110** and terminal **120** at the frequencies and power levels which were set in the earlier operations, at Block **622**.

It will be understood by those having skill in the art that a separate voice channel frequency and power level may be stored in the smart card **202** for the base station **110** and terminal **120**. The power levels may be different for the base station and the terminal if, for example, the base station has a larger antenna or a more sensitive receiver. It is also contemplated that the frequencies will be different since the terminal and base station would not typically transmit or receive on the same frequencies in a duplex transceiver. Alternatively, a single frequency and power level may be stored and a second frequency and power level may be determined from the single frequency and power level.

Accordingly, the network provider can use a frequency and power level indicating means such as a

smart card, to allocate frequencies and power levels of base station-to-terminal communications. By allocating the frequency and power level of base station-to-terminal communications, same frequency interference within a network cell is reduced and the network provider obtains additional revenue from the licensed frequency spectrum for the base station.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

CLAIMS:

1. A radio personal communications system comprising:

a radio personal communications terminal including first radio transceiving means;

a base station, electrically connected to a wire telephone network, and including second radio transceiving means for communicating with said first radio transceiving means; and

frequency indicating means, for removably coupling to at least one of said base station and said radio personal communications terminal, said frequency indicating means storing therein indications of at least one radio transmission frequency;

at least one of said radio personal communications terminal and said base station further comprising:

means for removably coupling said frequency indicating means thereto;

means for obtaining from the removably coupled frequency indicating means, signals representing said at least one radio transmission frequency; and

means for controlling at least one of said first and second transceiving means to operate at a frequency corresponding to the at least one radio transmission frequency.

2. The radio personal communications system of Claim 1 further comprising a radio personal communications network, wherein said radio personal communications terminal further comprises:

means for controlling said first transceiving means to communicate with said base station when said radio personal communications terminal is relatively close to said base station, and for controlling said first transceiving means to communicate with said radio

personal communications network when said radio personal communications terminal is relatively far from said base station.

3. The radio communications system of Claim 1 wherein said frequency indicating means is a smart card.

4. The radio communications system of Claim 1 wherein said radio personal communications terminal comprises a radio telephone.

5. The radio personal communications system of Claim 4 wherein said radio telephone is a cellular telephone.

6. The radio personal communications system of Claim 2 wherein said radio personal communications terminal comprises a cellular telephone and wherein said radio personal communications network is a cellular telephone network.

7. A radio telephone comprising:

radio transceiving means;

means for controlling said radio transceiving means to communicate with a base station when said radio telephone is relatively close to said base station, and for controlling said radio transceiving means to communicate with a radio telephone network when said radio telephone is relatively far from said base station;

means for removably coupling frequency indicating means, including at least one stored indication of a radio transmission frequency;

means for obtaining from the coupled frequency indicating means, a signal representing said at least one radio transmission frequency; and

means for controlling said radio transceiving means to operate at a frequency corresponding to the at least one radio transmission frequency.

8. The radio telephone of Claim 7 further comprising means for transmitting to said base station, a second signal representing said at least one radio transmission frequency, whereby said base station operates at a frequency corresponding to the at least one radio transmission frequency.

9. The radio telephone of Claim 7 wherein said frequency indicating means further stores therein a second indication of at least one power level, and wherein said radio telephone is further responsive to said second stored indication, for communicating with said base station at said at least one power level.

10. The radio telephone of Claim 7 further comprising means for processing voice, digital, video and multimedia communications to provide a radio personal communications terminal.

11. A base station for a radio telephone network comprising:

means for electrically connecting said base station to a wire telephone network;

radio transceiving means;

means for receiving a frequency indicating signal from external to said base station; and

means, responsive to said external frequency indicating signal, for operating said transceiving means at a frequency corresponding to the received frequency indicating signal.

12. The base station of Claim 11 wherein said frequency indicating signal receiving means comprises:

means for removably coupling frequency indicating means, including a stored indication of at least one radio transmission frequency; and

means for obtaining from the coupled frequency indicating means, signals representing said at least one radio transmission frequency.

13. The base station of Claim 11 wherein said frequency indicating signal receiving means comprises means for receiving a radio signal from a radiotelephone, corresponding to said frequency indicating signal.

14. The base station of Claim 12 wherein said removably coupling means comprises means for removably coupling a smart card including said stored indication of at least one radio transmission frequency.

15. The base station of Claim 11 wherein said frequency signal receiving means comprises means for receiving a frequency indicating signal and a power level indicating signal form external to said base station; and wherein said operating means further comprises means for operating said transceiving means at a frequency and power level corresponding to the received frequency and power level indicating signals.

16. A method of operating a radio personal communications system, said radio personal communications system comprising a radio personal communications terminal including first radio transceiving means; and a base station, electrically connected to a wire telephone network, said base

station including second radio transceiving means for communicating with said first radio transceiving means; said method comprising the steps of:

removably coupling frequency and power level indicating means to at least one of said base station and said radio personal communications terminal, said frequency and power level indicating means storing therein indications of at least one radio transmission frequency and power level;

obtaining from the removably coupled frequency and power level indicating means, signals representing said at least one radio transmission frequency and power level; and

controlling at least one of said first and second transceiving means to operate at a frequency and a power level corresponding to the at least one radio transmission frequency and power level.

17. The method of Claim 16 wherein said radio personal communications system further comprises a radio personal communications network, wherein said method further comprises the steps of:

controlling said first transceiving means to communicate with said base station when said radio personal communications terminal is relatively close to said base station; and

controlling said first transceiving means to communicate with said radio personal communications network when said radio personal communications terminal is relatively far from said base station.

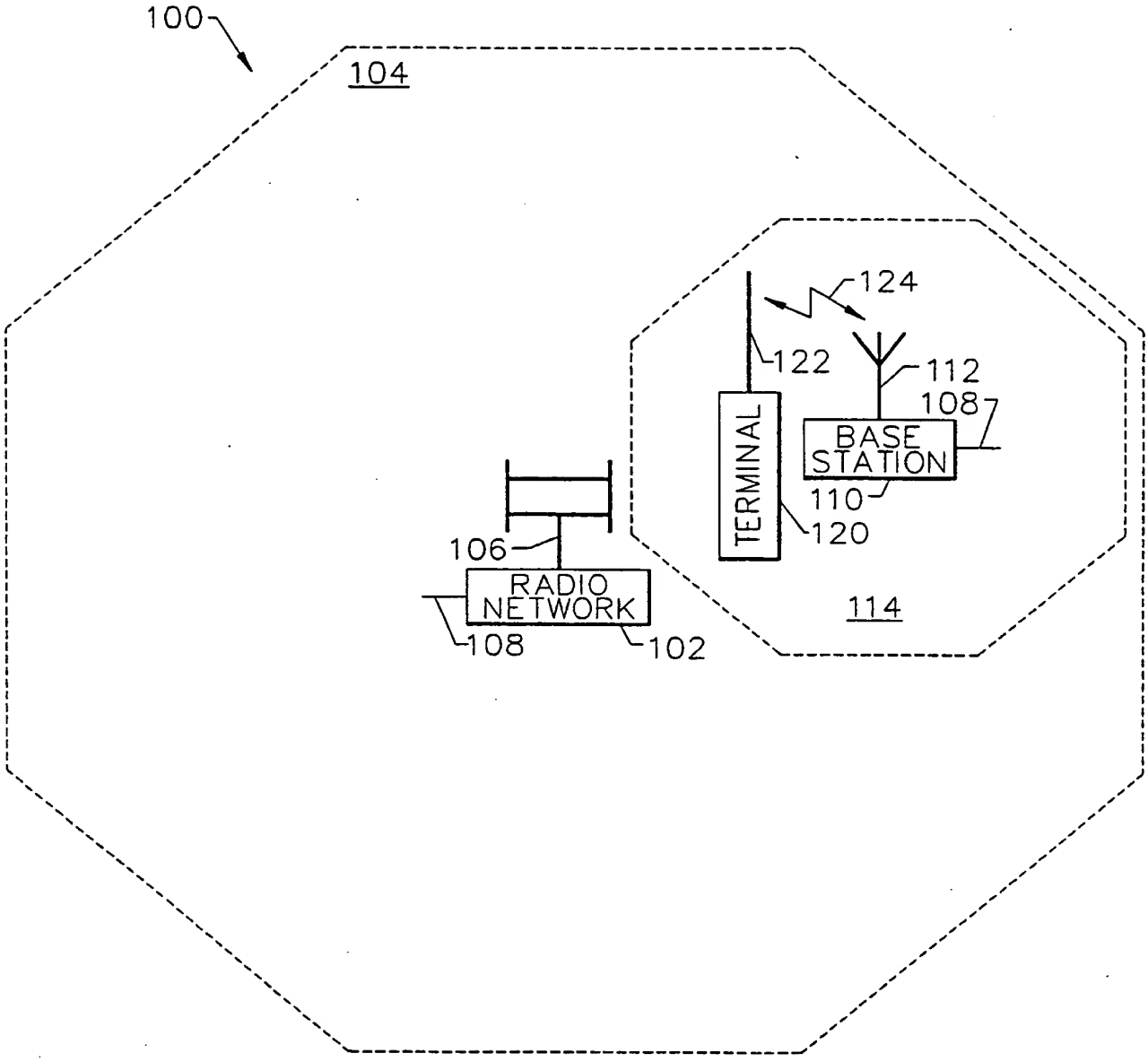
100
104
124
122
112
108
TERMINAL
BASE STATION
110
120
106
RADIO NETWORK
108
102
114

FIG. 1A.

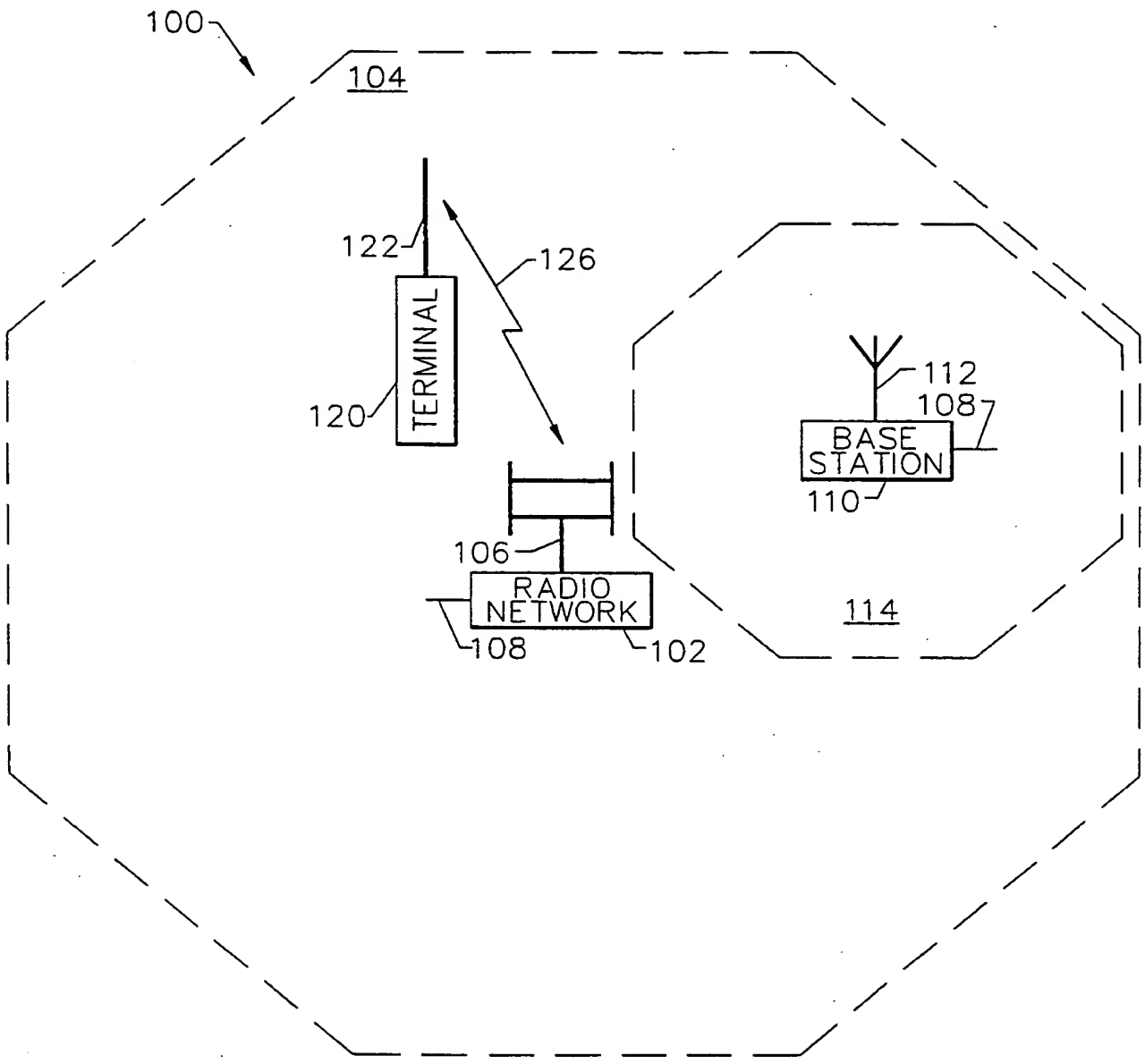
100
104
122
126
TERMINAL
120
112
108
BASE STATION
110
106
RADIO NETWORK
108
102
114

FIG. 1B.

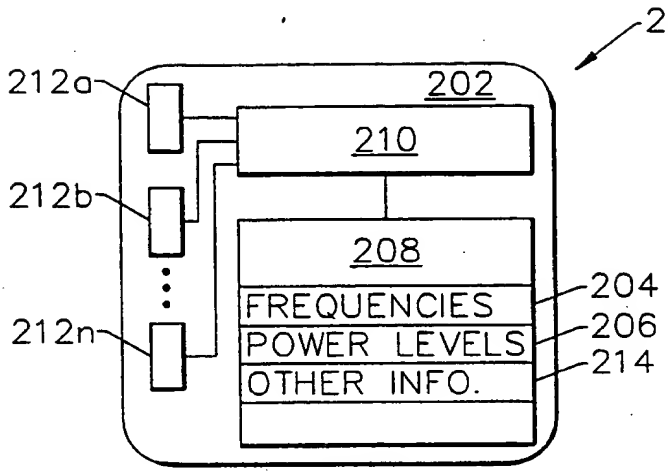
200
212a
202
210
212b
208
FREQUENCIES
POWER LEVELS
OTHER INFO.
212n
204
206
214

FIG. 2.

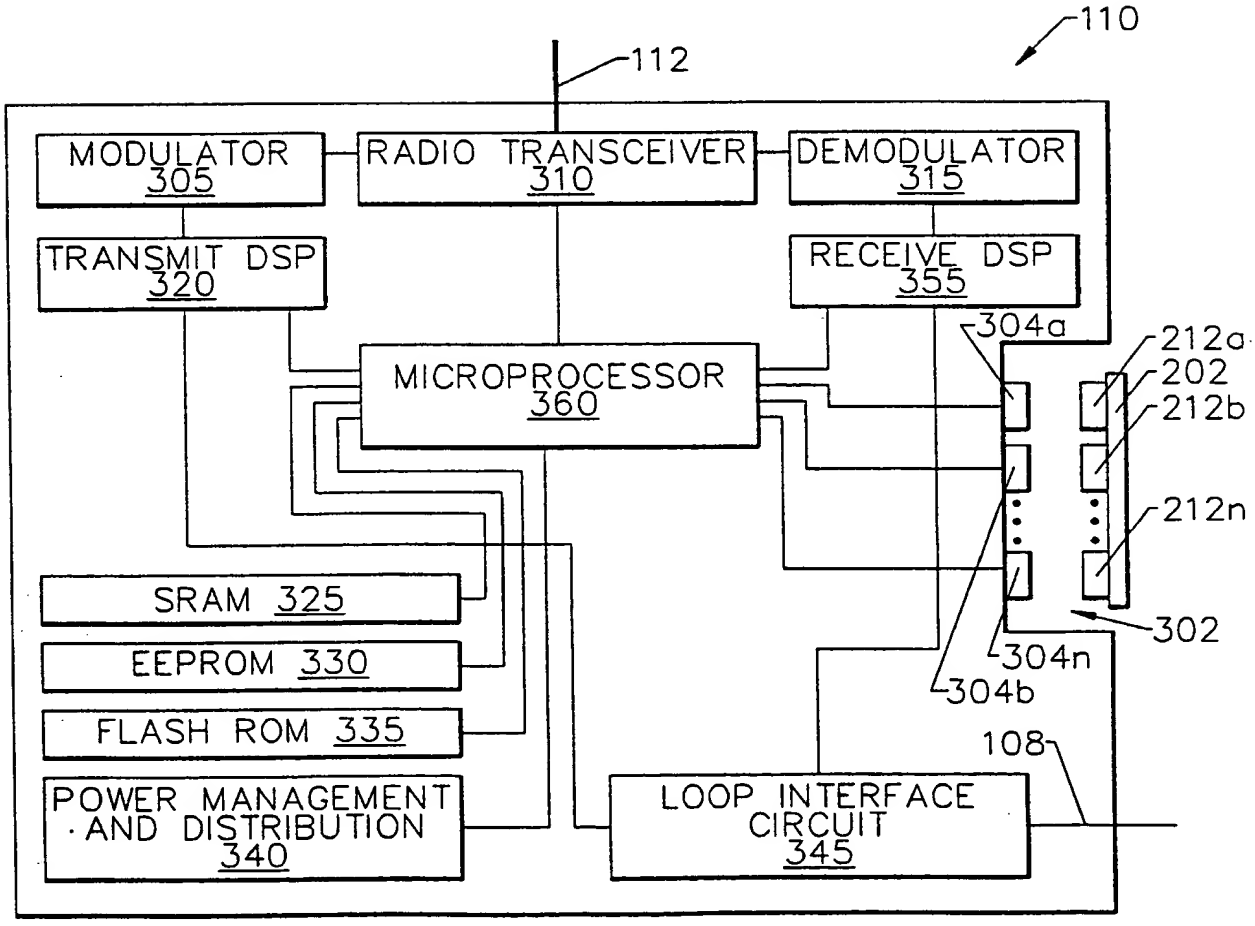
110
112
MODULATOR 305
RADIO TRANSCEIVER 310
DEMODULATOR 315
TRANSMIT DSP 320
RECEIVE DSP 355
MICROPROCESSOR 360
304a
212a
202
212b
212n
SRAM 325
EEPROM 330
FLASH ROM 335
POWER MANAGEMENT AND DISTRIBUTION 340
LOOP INTERFACE CIRCUIT 345
302
304n
304b
108

FIG. 3.

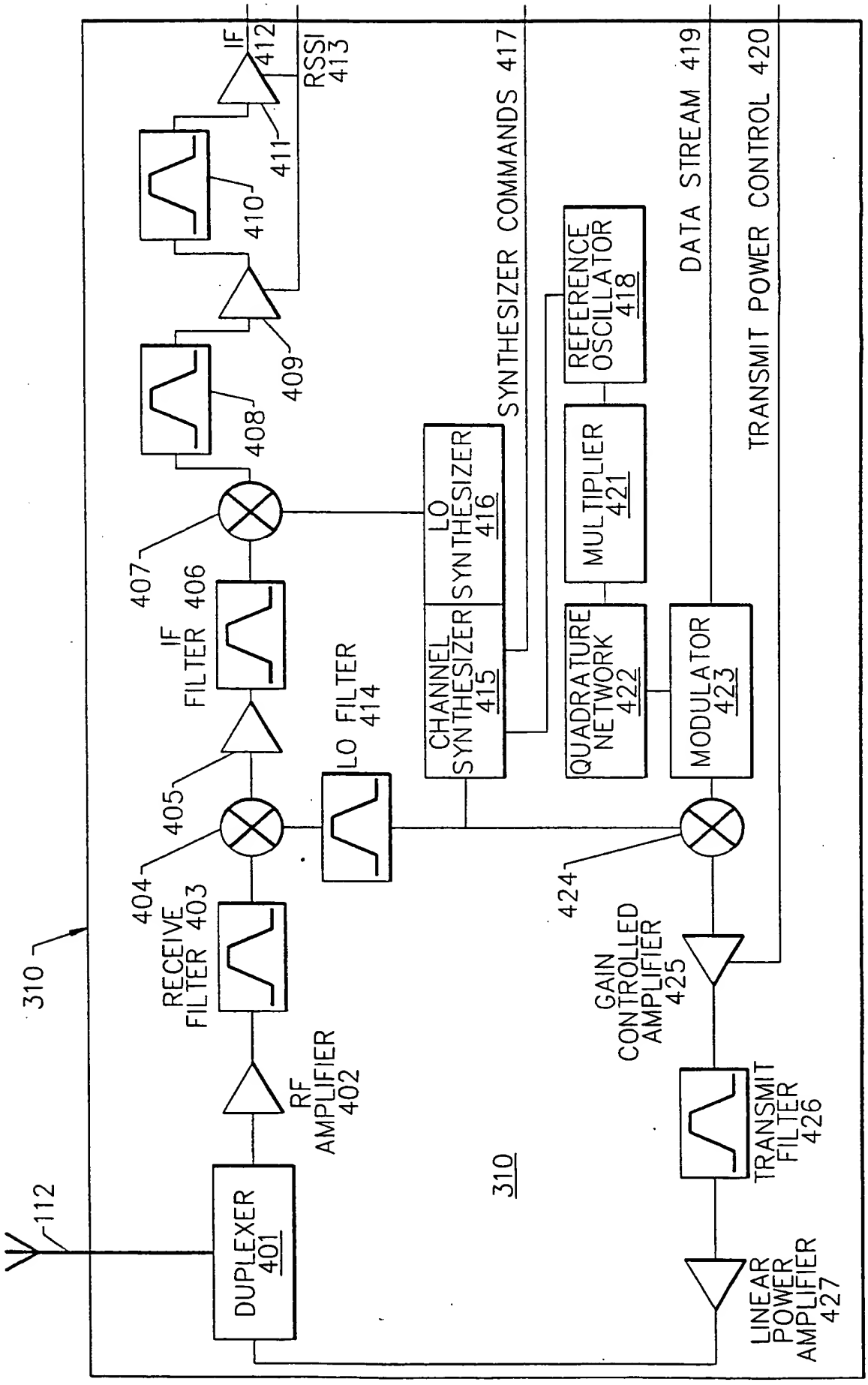
310
112
DUPLEXER 401
RF AMPLIFIER 402
RECEIVE FILTER 403
404
405
IF FILTER 406
407
408
409
410
411
IF 412
RSSI 413
LO FILTER 414
CHANNEL SYNTHESIZER 415
LO SYNTHESIZER 416
SYNTHESIZER COMMANDS 417
REFERENCE OSCILLATOR 418
DATA STREAM 419
TRANSMIT POWER CONTROL 420
MULTIPLIER 421
QUADRATURE NETWORK 422
MODULATOR 423
424
GAIN CONTROLLED AMPLIFIER 425
TRANSMIT FILTER 426
LINEAR POWER AMPLIFIER 427
310

FIG. 4.

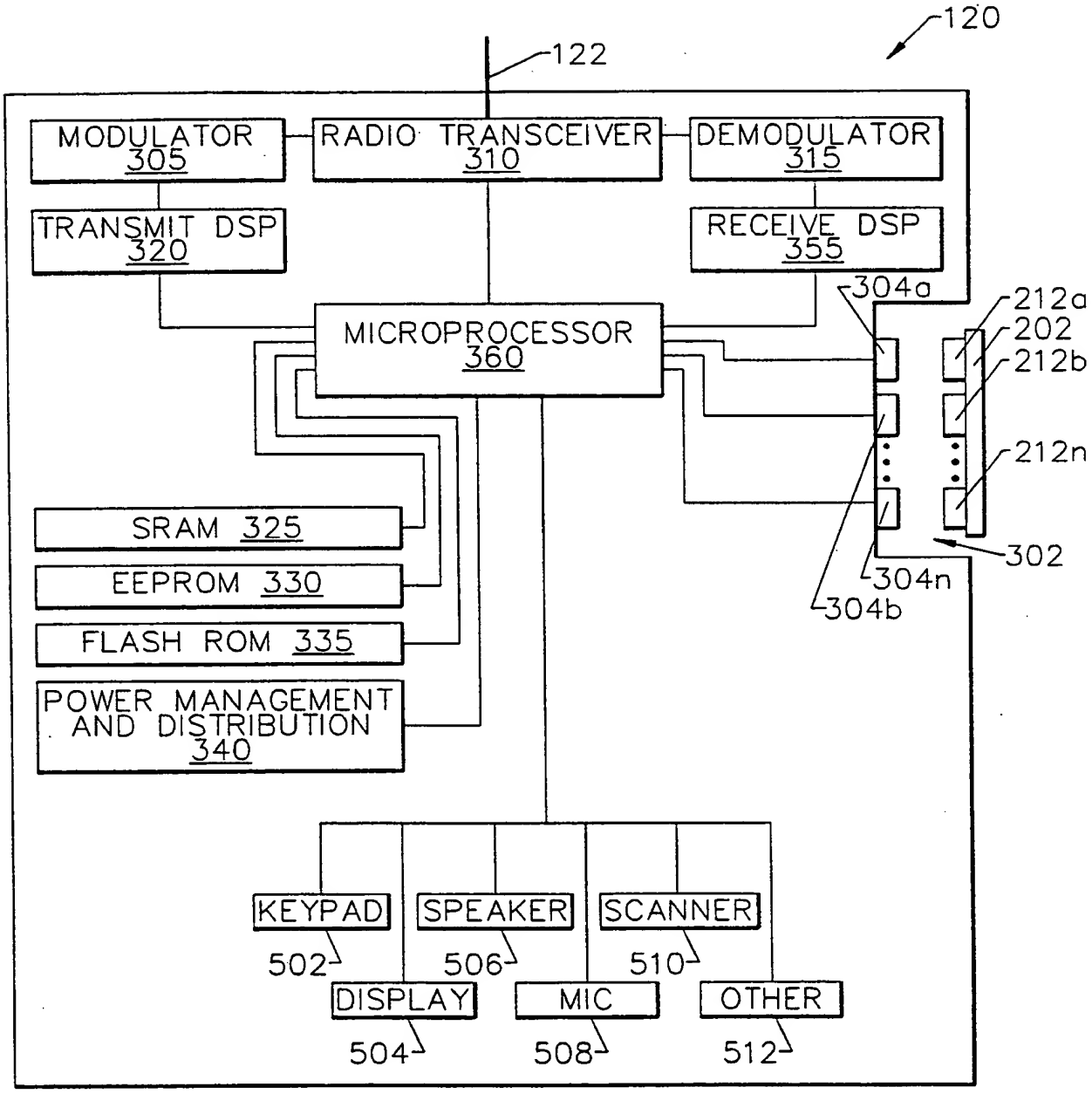
120
122
MODULATOR 305
RADIO TRANSCEIVER 310
DEMODULATOR 315
TRANSMIT DSP 320
RECEIVE DSP 355
MICROPROCESSOR 360
304a
212a
202
212b
212n
302
304n
304b
SRAM 325
EEPROM 330
FLASH ROM 335
POWER MANAGEMENT AND DISTRIBUTION 340
KEYPAD
SPEAKER
SCANNER
502
506
510
DISPLAY
MIC
OTHER
504
508
512

FIG. 5.

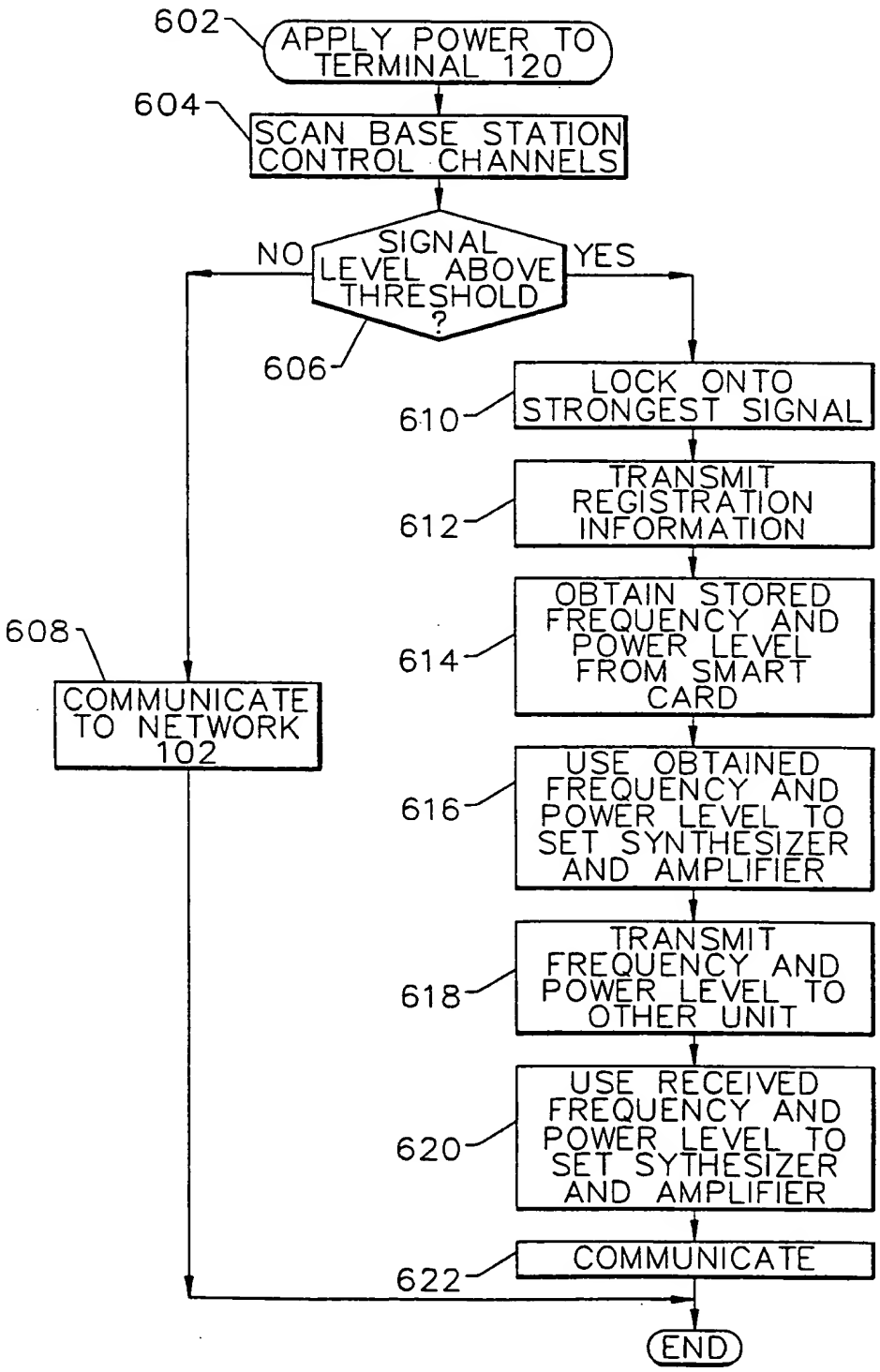
602
APPLY POWER TO TERMINAL 120
604
SCAN BASE STATION CONTROL CHANNELS
SIGNAL LEVEL ABOVE THRESHOLD ?
NO
YES
606
608
COMMUNICATE TO NETWORK 102
610
LOCK ONTO STRONGEST SIGNAL
612
TRANSMIT REGISTRATION INFORMATION
614
OBTAIN STORED FREQUENCY AND POWER LEVEL FROM SMART CARD
616
USE OBTAINED FREQUENCY AND POWER LEVEL TO SET SYNTHESIZER AND AMPLIFIER
618
TRANSMIT FREQUENCY AND POWER LEVEL TO OTHER UNIT
620
USE RECEIVED FREQUENCY AND POWER LEVEL TO SET SYTHESIZER AND AMPLIFIER
622
COMMUNICATE
END

FIG. 6.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 94/07617

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B1/38 H04Q7/32 H04M1/72

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B H04Q H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 280 196 (NIHON KOHDEN CORPORATION) 31 August 1988	1
Y	see column 1, line 4 - column 2, line 24	2-7,11, 12,17
A	see column 3, line 28 - line 54	16

Y	GB,A,2 260 468 (MATSUSHITA ELECTRIC INDUSTRIAL CO LTD) 14 April 1993 see page 1, line 2 - line 7	2,4-7
A	see page 2, line 8 - page 3, line 9; claim 1	16,17

Y	EP,A,0 538 933 (PHILIPS ELECTRONICS UK LIMITED) 28 April 1993	3
A	see column 1, line 44 - line 54 see column 2, line 14 - line 24 see column 2, line 58 - column 3, line 9; claims 1,7,8	1,14,16

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 October 1994	17. 11. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Goulding, C

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[redacted]national application No.
PCT/US 94/07617

C.(Conunuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB,A,2 225 512 (MOTOROLA INC) 30 May 1990 see page 1, line 11 - line 19	11,12,17
A	US,A,5 020 130 (GRUBE ET AL.) 28 May 1991 see column 1, line 13 - line 23	8,13

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US 94/07617

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0280196	31-08-88	JP-B-	5083009	24-11-93
		JP-A-	63207224	26-08-88
		US-A-	4903322	20-02-90
GB-A-2260468	14-04-93	JP-A-	5102923	23-04-93
EP-A-0538933	28-04-93	JP-A-	5218946	27-08-93
GB-A-2225512	30-05-90	US-A-	4989230	29-01-91
		JP-A-	3001621	08-01-91
		US-A-	5127042	30-06-92
US-A-5020130	28-05-91	CA-A-	1300233	05-05-92
		JP-A-	1255326	12-10-89